

The Over-the-Horizon Targeting (OTH-T) Program and the Reconfigurable Land-Based Test Site (RLBTS) Laboratory

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INTRODUCTION

The Over-the-Horizon Targeting (OTH-T) program conducts interoperability certification testing in accordance with Office of the Chief of Naval Operations instruction (OPNAVINST) 9410.5. OPNAVINST 9410.5 requires interoperability certification for new/upgraded systems to proceed to Operational Evaluation (OPEVAL). This instruction provides for configuration management, process and plan development, and requirements development for U.S. Navy and Joint interoperability testing.

To fulfill the charter of OPNAVINST 9410.5, the OTH-T program provides a virtual, global systems integration and test facility for Information Technology for the 21st Century (IT-21) command, control, communications, computers, intelligence, surveillance, and reconnaissance (C⁴ISR) technology. This technology collects, transmits, correlates, and displays track data into a Common Operational Picture (COP) to support warfighting requirements. The common view of the battle space that the COP provides the warfighter has been applied across the spectrum of warfare missions areas; however, the technology and doctrine have changed radically in recent years and continue to change rapidly. Thus, the primary goal of the OTH-T program is to transition architectures and systems from older military standard (MIL-STD) technologies to commercial/government off-the-shelf (COTS/GOTS) technologies. Another goal of the OTH-T program is to support the integration of all C⁴I systems into warfighting capabilities; this support included Year 2000 (Y2K) interoperability and integration testing and direct fleet support. Fleet support also includes providing technical expertise afloat and ashore through highly trained experienced Fleet Systems Engineers (FSEs) who ensure smooth integration of new C⁴ISR capabilities during major fleet exercises and demonstrations that validate and evaluate developed portions of configurations. The OTH-T program performs integration and interoperability testing to support warfighting capabilities for MIL-STD and IT-21 COTS/GOTS equipment for submarines, surface, and land-based components. The Fleet System Engineering Team (FSET) provides system engineers to support command centers and numbered fleet commanders; Officer in Tactical Command Information Exchange Subsystem/Tactical Data Information Exchange System (OTCIXS/TADIXS) network monitoring and troubleshooting support to Pacific Fleet/Atlantic Fleet (PACFLT/LANTFLT) command centers; data collection and analysis

ABSTRACT

This paper focuses on command, control, communications, computers, intelligence, surveillance, and reconnaissance (C⁴ISR) integration and interoperability testing accomplished by the Over-the-Horizon Targeting (OTH-T) program and the support that the OTH-T program provides the Fleet, including technical expertise afloat and ashore for submarines, surface, and land-based components. Test scalability from recent small-scale tests such as Web replication (Fleet-requested) to large-scale projects such as the Distributed Engineering Plant (DEP) are also discussed. This paper also addresses the Fleet Systems Engineering Team (FSET). FSET support provides system engineering to command centers and numbered fleet commanders, daily network monitoring and troubleshooting of the Officer in Tactical Command Information Exchange Subsystem/Tactical Data Information Exchange System to Pacific Fleet/Atlantic Fleet command centers, and data collection and analysis tools.

tools for FSEs (ashore and afloat); test coordination/direction for system integration testing; and coordination with other certification agencies.

BACKGROUND

Experiments in the 1970s showed the difficulty and problems associated with maintaining command and control across platforms with many individual platforms developing their own tactical picture and sharing that picture. The Office of the Chief of Naval Operations (OPNAV) established the OTH-T program in 1985 to address these problems. The OTH-T program was originally tasked to develop communications specifications and Battle Group Data Base Management (BGDBM). The objective of the OTH-T program is to produce a complete, accurate, timely, precise, tactical picture suitable for getting ordnance on target where all participants have access to the correct information. The OTH-T program established the Reconfigurable Land-Based Test Site (RLBTS) in 1989 to allow interoperability and integration testing. The OTH-T program is funded through OPNAV N6 and receives Operational Maintenance, Navy (OM&N) funding to support the RLBTS Laboratory and facilities. Other major sponsors include Space and Naval Warfare Systems Command (SPAWAR) PMW 157 and 165, and PACFLT.

THE RECONFIGURABLE LAND-BASED TEST SITE (RLBTS) LABORATORY

In the early 1990s, the Navy designated the RLBTS Laboratory as the lead OTH-T laboratory. RLBTS was established as a facility to support the development of tactics and procedures for targeting systems and weapons, concept demonstrations of prototype systems, and the definition of architectures intended to ease future acquisition decisions. RLBTS provides the Navy with a facility that maintains command, control, and communication systems expertise to ensure technical and scientific excellence that provides the corporate knowledge, technical networking innovation, and real-world understanding to support operationally effective fleet warfare mission area systems. The OTH-T program operates RLBTS as a full-service facility for conducting Joint Distributed Tests and Evaluations (DEP and Joint DEP) and OTH-T system integration interoperability tests and certifications. RLBTS is expandable to support command and control configurations from the platform level to the afloat/ashore Command Center level. RLBTS provides a test control center hub, network operations center (NOC), a focal point for all test data collection and analysis, a classified test environment, architecture development and validation, and network engineering to support Fleet Command Centers.

Figure 1 shows a combined view of Joint Operation Test Site (JOTS) workstations and the multimedia center. The large screen display (Figure 1) can be connected to any workstation and various videoteleconferencing (VTC) units. A whiteboard and VTC unit are permanently connected to SPAWAR Headquarters (SPAWAR HQ) and SSC Charleston for collaborative real-time test planning and test execution. Figure 2 shows the Tactical Analysis Section of the laboratory. These machines house the Repeatability Performance Evaluation and Analysis Tool (REPEAT) used for tactical data recording, analysis, and playback. Figure 3 shows

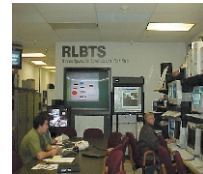


FIGURE 1. The RLBTS Laboratory.



FIGURE 2. The Tactical Analysis Section of the RLBTS Laboratory.



FIGURE 3. View of REPEAT machines and JOTS1 tactical workstations.

REPEAT machines and JOTS tactical workstations in the Tactical Data Section.

Network infrastructure supported by the RLBTS Laboratory (Figure 4) includes secure fiber connections to other laboratories, including the Integrated Shipboard Network System–Test Facility (ISNS–TF) (NOC); Integrated Test Facility (ITF); Integrated Combat System Test Facility (ICSTF, NAVSEA); Research, Evaluation, and Systems Analysis (RESA); Global Command and Control System–Maritime (GCCS–M), and Systems Integration Facility (SIF), with T1 and Asynchronous Transfer Mode (ATM) connectivity to SPAWAR–HQ, SSC Chesapeake, and SSC Charleston. Network connectivity also includes the Systems Integration Environment (SIE) Upgrade (T1)/Defense Information Systems Network–Leading Edge Services (DISN–LES, ATM); DEP/DISN–LES; Defense Research and Engineering Network (DREN); Ship Wide-Area Network/Secret Internet Protocol Router Network (SWAN/SIPRNET); and SSC San Diego networks. The RLBTS Laboratory also maintains a satellite communications capability to PACFLT and LANTFLT assets. RLBTS Laboratory assets include routers, packet shapers, ATM switches, firewalls, cryptos, multiplexers, and satellite simulators. Additionally, a capability to emulate the Integrated Shipboard Network System (ISNS) shipboard network has been developed by the OTH-T Program.

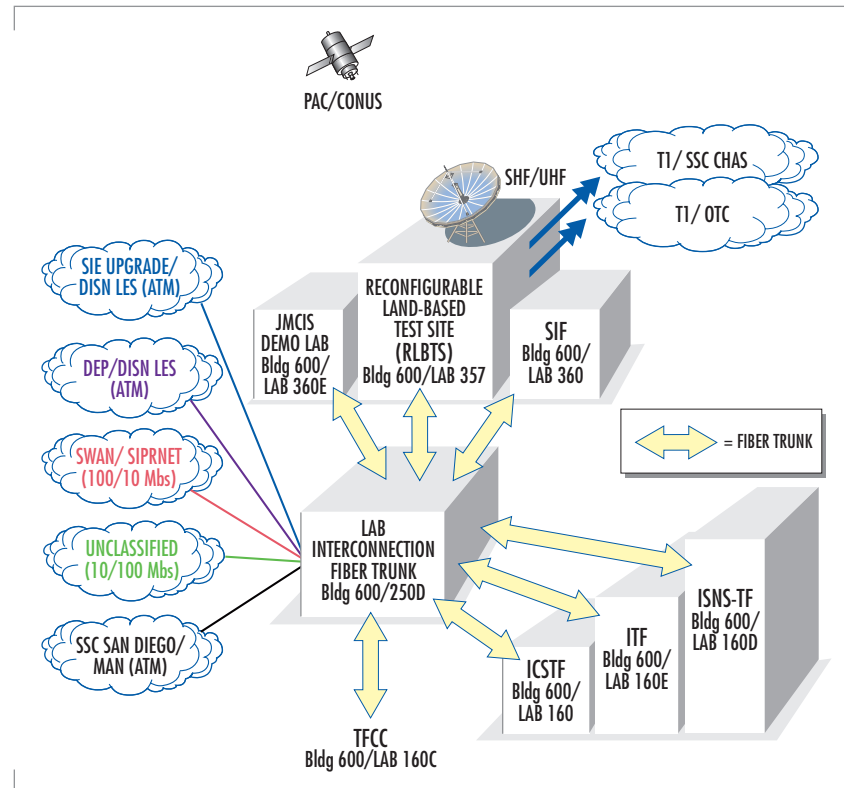


FIGURE 4. RLBTS networking communication and laboratory interconnection.

TESTING AND OTHER ACCOMPLISHMENTS

The OTH-T program has certified the interoperability of systems and software including OASIS, GCCS–M, Combat Control System (CCS) MK II, and the Advanced Tomahawk Weapon Control System (ATWCS). These certifications are performed annually or as new versions or software patches are developed for the Fleet to meet OPNAVINST 9410.5 requirements.

During FY 1999, the OTH-T program conducted systems integration, interoperability, and Y2K testing using the facilities of the Land-Based Test Network (LBTN), and expanded RLBTS to validate IT-21 technologies prior to shipboard installation. The OTH-T program conducted 27 tests, recommended certification of 3 systems during 59 test weeks, produced 229 documents, and provided 43 Software Trouble Reports (STRs) to program managers and system developers. OTH-T team members also

participated in the DEP Battle Group Interoperability Test (BGIT) for USS *Dwight D. Eisenhower* (CVN 69) and USS *George Washington* (CVN 73), and developed and tested the COP Synchronization Tools (CST) functional requirements.

During FY 2000, the OTH-T program conducted integration and interoperability testing using the LBTN, SIE, and the IT-21 infrastructure in the RLBTs Laboratory connected to various facilities around the U.S. The OTH-T program conducted 29 tests, recommended certification of GCCS-M 3.1.2.1 and CCS MK II during 149 test weeks, produced 191 documents, and provided 91 STRs to program managers and system developers. Forty briefs were given in the RLBTs Laboratory.

The OTH-T team supported the DEP BGIT of *Eisenhower*, *George Washington*, USS *Carl Vinson* (CVN 70), and USS *Constellation* (CV 64) BG C4ISR configurations. The OTH-T team's participation in the test readiness reviews, test execution BGIT analysis review panels, and scheduling meetings for SPAWAR led to the identification of 24 Test Observation Reports (TORs). TORs are used to isolate problems and provide a fix or work-around recommendation.

Interoperability and Integration Testing

Specific interoperability and integration testing was accomplished for the CST segment in GCCS-M and GCCS-M version 3.1.2.1. Fifty-six STRs were recorded with 30 high, 18 medium, and 8 low. These STRs were passed to the developer and sponsor and recorded in the OTH-T database. Certification was recommended with Interim Authority to Operate (IATO) in the Fleet. As a follow-on to the certification testing, OTH-T test engineers participated in developmental testing / operational testing (DT/OT) and OPEVAL with USS *Enterprise* (CVN 65) at sea. The DT/OT demonstrated the capabilities of the GCCS-M/CST software. The OTH-T program also provided test procedures and lessons-learned reports. As this software is installed in the Fleet, the OTH-T program provides technical support and additional testing as requested by users.

Interoperability certification tests were conducted for the submarine weapons CCS MK II. Interoperability certification was recommended for the CCS MK II system. During DT, eight STRs were identified. These STRs were identified before certification, and fixes or work-arounds were implemented.

Additional interoperability/integration testing included joint testing with the Joint Interoperability Test Command (JITC). The RLBTs Laboratory participated as a node on a wide-area network (WAN) on SIPRNET testing of GCCS-M and GCCS-J (Joint). Additional participants were the Naval Center for Tactical Systems Interoperability (NCTSI) and the Defense Information Systems Agency (DISA).

Repeatable Performance Evaluation Analysis Tool (REPEAT)

The OTH-T program initiated the development of REPEAT and supports its maintenance, use, distribution, and continued development. REPEAT monitors and tests all C4I synchronous and asynchronous serial devices. REPEAT monitoring and testing allows the user to conduct statistical analyses on volume and type of data, system throughput and timeliness, tactical data network loading, correlation accuracy, system data loss, common tactical picture, and comparison of data transmitted and received at various locations. Message formats that are currently supported include OTH-Gold, TACREP, TADIL-A, TADIL-B,

TADIL-J, RAINFORM, Tactical Information Broadcast System/Tactical related application Data Distribution System (TIBS/TDDS), Tactical Electronic Intelligence (TACELINT), LOCATOR, Tactical Receive Equipment (TRE), Tactical Fire Direction System (TACFIRE), and Sensor Tactical Contact Report (SENSOREP). REPEAT tests OTCIXS/TADIXS/SIU/V6 interfaces. The OTH-T team provides software support, training, and upgrades. REPEAT is available in MS-DOS and Windows versions. REPEAT is currently installed and used for data analysis and recording at over 300 military sites at more than 55 commands and allied militaries. More than 300 help calls are handled each year. REPEAT software is available to all U.S. military at <http://repeat.spawar.navy.mil>. REPEAT provides scenario development and data/platform injection for Joint Warrior Interoperability Demonstration (JWID) exercises. During FY 2000, REPEAT supported the Global Positioning System (GPS) Inter-Service Agreement (ISA) Demonstration (sponsored by Fleet Battle Laboratory), specifically injection of GPS messages into GCCS-M. REPEAT is currently installed on many Navy platforms and is used by the Fleet to identify problems.

Test Process Web-Enabled

The OTH-T program maintains a password-protected Web site at <http://otht.spawar.navy.mil> to support the OTH-T team and promote process documentation, process improvement, and configuration management. The Web site allows documentation development, a tester log, engineering notes, test planning, and process documentation.

FLEET SYSTEMS ENGINEERING TEAM (FSET)

The OTH-T program supports the Fleet Systems Engineering Team (FSET), which is the main technical advisor to carrier Battle Group (CVBG)/amphibious ready group (ARG) staffs in matters related to the IT-21 architecture, associated C⁴ISR/information operations (IO) systems, and supporting networks and infrastructures. Besides serving as a technical liaison on system management issues, the FSET also interfaces with those baseband systems that provide connectivity between the shore and shipboard networks. This connectivity includes Challenge Athena, super high frequency (SHF), Automated Digital Network System (ADNS), and other line-of-sight systems. Integrated with LANTFLT and PACFLT Commander-in-Chief (CINC) N6 organizations, the FSET also monitors all CVBG/ARG C⁴ISR installations and liaisons with ship C⁴ installation supervisors to verify that all required connectivity is in place to support tactical operations.

Coordinated with the RLBT Laboratory, the FSE team provides system engineering support for experiments and tests that support the introduction of new SPAWAR Common Operational Picture (COP) software/hardware or system capabilities. Systems engineering will support pre-test coordination, test design, installation test and coordination, and onsite support when required at remote facilities, data collection and analysis, injection of synthetic data, and post-test lessons-learned reports. FSETs provide daily support to the numbered commanders and CINC staff and their command Assist CINC in developing C⁴I architectures and requirements. Support includes system-level support for C⁴I non-real-time systems during BG work, Battle Group Systems Integration Test (BGSIT), and exercises (for example, Joint Task Force Exercise [JTFEX], Cobra Gold, Kernel Blitz, Tandem Thrust, and Magellan).

As representatives of SPAWAR and the Fleet CINC, the FSET ensures that deploying forces have ready access to technical experts familiar with the IT-21 architecture from an installation and operational point of view. FSET support is available upon request to major staffs throughout their deployment workup cycle. The FSET provides the ship, staff, and Battle Force an "on-scene" representative, uniquely experienced in the afloat architectures. Information on how to request FSET support is available by contacting either the LANTFLT or PACFLT program managers. In coordination with the OTH-T program, the FSET provides rapid response problem solving for issues encountered in the Fleet.

LOOKING FORWARD—THE FUTURE

With the infrastructure that has been established in the RBLTS Laboratory and connections to many other facilities from the RLBTs Laboratory, the future looks busy and full of new opportunities. These opportunities are described in the following subsections.

Multiple Large-Deck BG Interoperability Testing

Multiple large-deck BG interoperability testing ensures that multiple large-deck BGs can communicate and share data for collaborative planning, COP, and dissemination of (air) tasking orders on virtual local-area networks (VLANs), LANs, or WANs. This testing is required as a result of previous fleet observations of conflicts that involved multiple BGs converging in an operational theater with interoperability problems that forced technical experts to quickly respond to the BGs and implement work-arounds to ease operations—a costly occurrence. Multiple large-deck interoperability testing of C4ISR systems has never been executed in preparation for multiple large-deck contingencies.

Prioritized Products List (PPL) Testing

Prioritized Products List (PPL) testing for intensified rapid-response interoperability testing is required because of changing shipboard infrastructure and networks, the use of multiple vendors, increased complexity of systems and software, an increased number of nodes/participants, increased geographic extent, and the complexity of required networks. Equipment upgrades and evolutions require more regression testing, verification, and validation to ensure and certify that new and legacy software function according to specification and interoperate with other equipment and platforms. Critical issues include WAN/bandwidth management and the extent of impact of applications when WAN bandwidth is constrained or dirty satellite conditions exist. Interoperability problems will become evident when hardware and software are installed in the Fleet and during fleet operations rather than in the laboratory. Mission capabilities will be reduced. Costs to repair problems and develop *ad hoc* fixes found in the Fleet will greatly exceed costs to identify and fix problems found in an ashore test environment. The OTH-T program with the RLBTs Laboratory is ideal for this PPL testing because of existing NOC, Integrated Shipboard Network System (ISNS), satellite simulation, and WAN facilities and expertise.

CONCLUSION

The OTH-T program will continue to provide the Fleet with high-quality products in the conduct of integration and interoperability testing of OTH-T and combat systems with tactical data exchanged over CST networks and other networks. Integration testing will include testing of GCCS-M and Combat Decision Systems (CDS) two-way interfaces. The OTH-T program will continue to support FSET integration tests and fleet test requests, horizontal integration, relevance verification, modification recommendations, and OTH-T specification maintenance to support distribution of C⁴ISR systems to the Fleet, and participate in DT, OT, and OPEVAL as required. OTH-T will also provide certification testing as required by OPNAVINST 9410.5.



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